Seven Years in Sixty Minutes:
The Most Important Things I Learned About Goats for Fire Management

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Introduction

In 1998 I began a research project with 11 goats, another novice goat herder, and a desire to provide fire managers and communities the answers they need in order to feel comfortable choosing goats as a tool for reducing fire danger. Thanks to donations of goats from other research projects, a healthy breeding program, the efforts of Utah National Guard's Camp Williams Training Facility, and funding from the Joint Fire Science Program beginning in 2000, the program grew to 130 goats and a small staff. The result is a handbook on CD called “Goats! For Firesafe Homes in Wildland Areas” which is now available at http://www.livestockforlandscapes.com. The CD expands on the lessons that I will share here.

Why Consider Goats as a Tool?

An aggressive, fifty-year policy of fire suppression has resulted in an accumulation of wildland fuels and an increase in fire intensity and resistance to control. This is a particular problem in the shrub-dominated communities typically found in the lower foothills and mountain areas which are increasingly popular for housing developments and second homes. The deadly 1994 South Canyon fire that killed fourteen firefighters, was fought in oakbrush on steep slopes just a mile from two small Glenwood Springs, Colorado subdivisions. Similar housing developments throughout the country mix seamlessly with oakbrush and mountain brush, and it is increasingly difficult to protect these homes from fire.

The proximity to housing developments affects the way managers control fire fuels. While controlled burning is effective, homeowners are concerned about threats to their property. In addition, increased regulations on smoke and particulate matter output limit its use. Removing brush mechanically is both costly and difficult due to rugged terrain and multiple treatments required. Herbicide is unpopular with residents who fear damage to their own landscaping.

In a few cases, fire managers have turned to goats as a way to reduce fire danger to private property, to eliminate smoke concerns, and to enhance success in rugged terrain. Goats are able to eat a broader variety of vegetation than sheep or cows, are comfortable on steep slopes, and use their athletic balancing and climbing abilities to reach branches over 6 feet in height. They are also popular in areas where they have been used, as evidenced by the wine and cheese parties that Laguna Beach, California residents hold when goats come to their neighborhood to work.

But this tool has not achieved widespread acceptance for a number of reasons. First, fire managers are unfamiliar with the “hows” of managing goats for fuel reduction. Second, if they were to use this tool, there was little information on how much fuel should be removed, no evidence of its efficacy, and no models of fire behavior in treated areas. Finally, finding an ample supply of goats and a herder with the necessary experience is difficult.

To help fire and goat managers alike, here are the high points of what I learned from 1998 to today. I’ll start by answering the questions I’m asked most often, and then give you my “Start-Up Success Secrets” to help you begin your own projects.
Does it Work?

The simple answer is yes. This study and others demonstrate that goats will eat and thrive on brushy species. The changes they can make in the fuel load are significant and fire behavior modeling and an actual fire demonstrated that treatment areas do slow and stop a fire.

Vegetation Reduction

For this project we were interested in shrub-dominated vegetation types such as California mixed chaparral, pocosin shrub, southern hardwood shrub, and oakbrush/mountain brush. To fire managers these types are known as Fire Behavior Fuel Models 4, 5, 6 and 7 (Anderson, 1982). These shrub communities share some commonalities that are important to fire managers. First, they are often found as part of the understory in forests where fire has been suppressed. Second, an increasing number of housing developments are located in these communities. Third, firefighters experience difficulty in controlling fires in these species because they tend to have a high concentration of volatile oils and waxes. Finally, they share a similar response to fire and mechanical treatments. In most cases these species re-sprout prolifically after fire or mechanical top removal (Bradley et al.). This means that each area must receive multiple treatments to maintain benefits. Not only is this economically prohibitive, but repeated fire can also lead to lowering of soil-nitrogen availability (Hobbs and Schimel, 1984). In addition, repeated fire treatments may also lead to a change in stand composition. For example, given their tremendous sprouting potential, oakbrush and maple have a competitive advantage over other shrub species in disturbed stands and over time can out compete them and other herbaceous vegetation.

Previous research demonstrated that goats can effectively reduce shrubby vegetation. Pearson and Martin (1991) found that goat grazing opened the canopy and improved herbage on their test plots in the Ouachita National Forest in Arkansas. Research done by Tsiouvaras et al. (1989) and Green and Newell (1982) in California forests showed that goats would eat a wider variety of plants than other livestock and successfully reduced chaparral vegetation types. Indeed, the City of Laguna Beach has seen such success with goats that they have an annual contract to use 500-800 goats to graze a 1,445-acre “Moat” around the city (Phillips, 1984). Davis et al. (1975) and Riggs and Urness (1988) found that goats will eat oakbrush without experiencing toxic side affects common to cattle. Further, these studies demonstrated that at least two consecutive defoliations in a year by grazing goats successfully controlled re-sprouting. Both found that timing of the grazing amplified the effects by taking advantage of low carbohydrate root reserves in late June (full leaf stage) and August (late summer re-growth). In a follow up study that remains unpublished, Urness also found that the stand structure in their study area remained altered after five years (D. Austin, 1998, personal communications). More open space remained between clumps of vegetation. These more "park-like stands" provide wildlife habitat and might be less prone to carry a fire.

With this as our background we began two years of pilot grazing using small herds to demonstrate effectiveness and to develop initial solutions to the logistical problems of managing and caring for the animals. Based on observations during the pilot grazing seasons (1998 and 1999) a hypothetical curve of biomass reduction was developed. This curve showed a relatively short amount of time to achieve an initial decrease in the amount of biomass in a paddock, followed by a four week period of re-growth, and then a second much shorter period of grazing to remove all re-growth.

Measurements taken in the research plots during the 2000 grazing season showed results very much in line with the hypothesis. The rate of the initial decrease is variable depending on the number of goats, the size of the pen, and the amount of biomass available. In this case with approximately 2,000 pounds of goats (or 17 animals) it took from ten to fourteen days to complete each 100’x 200’ paddock. Paddocks had between 4 and 5 weeks of re-growth when goats returned. Re-growth was consumed in two to four days. Using this information, managers might understand what kinds of changes can be achieved, how much time should be allowed to provide for changes in fuel loads and
heights, and extrapolate the number of miles of fuel breaks that might be possible for initial treatments and for maintenance.

Fire Modeling and Post Fire Results

We coupled this data with a fire behavior modeling tool called “FARSITE.” The results indicated that surface flame length, fireline intensity, crown fire, and spotting were all reduced significantly in the treated areas. Then, when a training exercise at Camp Williams caused a fire on July 16, 2001, we got to see if reality matched the model.

Fanned by temperatures in the nineties and winds gusting from 30 to 60 miles per hour, the fire quickly reached Beef Hollow, where the goat research plots were located. Technicians cut the fences and ran the goats about a mile down to the Field Ammunition Storage Point (ASP) surrounded by a twelve-foot chain link fence. Fire managers estimated that technicians had at least 45 minutes before the fire would enter Wood Hollow where we had a group of goats working on a logistics demonstration. But the fire increased in both speed and intensity. Thirty minutes later, with the goats penned on a safe zone of dirt and gravel, technicians left the area as flames leapt across the road and moved on towards the nearby subdivision. Four days, 12,000 acres and $500,000 later, the fire was declared out.

In the days after the fire, we took video and pictures to record the effects of the fire and the goat treatment sites. In Beef Hollow, where the fire was relatively young and cool, and winds were constantly shifting, there was a mosaic of burned and unburned areas. Goats had only completed the A sides of plots 1, 2, and 3. The fire did not enter any of these paddocks. In plot 1B, the only vegetation that burned was the twelve foot oakbrush at the roadside edge of the plot. The rest of paddock 1B remained unburned even though the goats had only been in that paddock for a day. Other B paddocks were fire-free as well. Posts and polywire at the edges of the plots melted, but firefighters later told us that they had seen 15 foot flame lengths drop to two feet and then burn out when meeting the goat plots. Most interestingly, plots 4, 5, and 6 remained unburned and green, though the goats had only worked there in 2000.

By the time the fire reached Wood Hollow it was much hotter and was burning everything in its path. The goat treatment site was not touched and it seemed that the vegetation behind it had received a degree of protection. Rather than burning, the oakbrush there only scorched. By the end of the summer, it had re-sprouted to green again. Meanwhile, the area thinned by the hotshot crew just the week before the fire burned over completely.
Where and When Does It Work?

The fire indicated that goat treatments do work, but the success of this tool, like any other fire management tool depends on its placement and size. Past fire history can play a role in determining where a fire is most likely to start and which direction it will head. The steepness of slopes, or width of canyons will dictate how wide, and how long treatment areas should be. Finally, timing of the treatment is critical. We were initially concerned that re-growth might render the treatment sites ineffective. The Camp Williams fire showed that the three weeks of re-growth in Wood Hollow did not reduce the treatment's fire resistance. This indicates that treatments can be done before the "heat" of the fire season. Suggestions for using Geographic Information System technology to map potential goat treatment zones are included on the CD handbook.

Start-Up Success Secrets

I would like to be able to give you a step-by-step plan for your startup, but creating one suitable for every situation is impossible. A short list of steps follows. I offer these suggestions with the expectations that you will adapt them to your own needs and level of experience.

First Rule of Success - Location, Location, Location

The site you choose must have three characteristics:

1. Suitable for fire prevention

   Fire managers must be involved in the selection of a treatment site. Their experience with potential fire history, behavior, and placement of other firefighting resources is critical to working in a location and at a scale that will do the most good. A goat firebreak is not a guarantee that the fire will stop. It may, but if it doesn't, the firebreak can be a way to slow the fire so that strategically placed firefighters can stop it permanently. It provides them with a degree of safety when they are trying to defend private property.

2. Accessible for goat unloading, loading, and watering

   Adjust the site location or starting point to ensure that animals can get to the area, and have access to water. Different herds and herders have different capabilities, so work with each other to achieve success. I'd recommend a place close to the road, so that you can move goats in and out and water them easily.

3. Provides the proper level of visibility for the project

   Depending on the scale of the project and your level of experience, visibility may or may not be a good thing. If things go poorly for you, not only will your business or your agency suffer, it could also impact how others look at using goats down the road. Your success or failure could mean that goats become popular or become pariahs.

   When we began, our project had very little visibility. This worked well because it gave us an opportunity to learn from our mistakes without impacting anyone else. Visibility increased with our skill and comfort level. I offer that if you are just getting started, make decisions about the size and visibility of the project that coincide with your level of experience. For example, if you are working in a very visible location, such as the backyards of a small subdivision, consider using a smaller number of goats initially, and increasing the herd size as you and the neighbor become more comfortable.

Pilot Projects
Get started with "Pilot Projects." They can show communities what goats are all about, can give you a chance to invite the media to a field tour, and allow you time to work out any bugs, test your assumptions, and adjust and adapt to unforeseen issues. A small, successful demonstration is much easier on you, on the goats, and on the growing fire/weed goat industry. Pilot projects are also good opportunities for partnering and sharing costs among communities, agencies and organizations.

**Pen Size**

Pen size is critical; too small, and you'll wear yourself out moving fence and too large the animals won't focus as well on their work. Land managers and goat service providers can work together to estimate the amount of forage in an area. Based on the estimate you can choose the right number of goats and select an appropriate pen size. The Goat Calculator in the CD handbook can also help you.

**A Goat-Proof Fence**

The right fencing is critical to your success. A fence focuses the animals on their task, keeps them from eating neighbors’ landscaping, and provides some protection from predators. We tested a variety of fencing styles and the results are included in the CD handbook along with information on how to live by these “Five Fencing Commandments:”

1. Select the right fence for your job.
2. Build your fence correctly.
3. Do simple daily maintenance.
4. Train the goats to the electric fence BEFORE you put them in a working field situation.
5. Ensure that your goats have everything they need inside the fence so they won’t want to leave.

**Experienced, Healthy Animals**

Goats are not born knowing what to eat. They learn from their mothers, from their peers and through trial and error. Thus having animals with prior experience with the forages you are working on decreases learning time, and increases productivity. You can also use their ability to learn in combination with supplements to help them eat more of forages containing toxins.

Keep your herd healthy and ready to eat by giving them their shots, worming them, and keeping their feet trimmed. Be aware of diseases such as Johne’s that have the potential to silently contaminate your herd or keep them from being legally transported to other states.

**Clear Contracts**

A good contract describes what the area should look like when the goats are done, provides for public safety, and addresses things like mitigation for weeds, feral animals, damage to surrounding landscaping, etc.

**Hard Work**

Thomas Edison once said, "Opportunity is missed by most people because it is dressed in overalls and looks like work." This opportunity is no different. I think the successful goat entrepreneur is someone with a degree of marketing skill, who is willing to work long days in heat or cold, who can explain himself to people and to goats, and most importantly, is flexible and imaginative enough to find a variety of right answers to every problem. A sense of humor is also important, because there are days that if you don't laugh, you'll probably cry.
Conclusion

I fully expect that you will combine what you find here with your own expertise in fire or goat management and your understanding of the area in which you work. I hope this information will help increase the use of goats, and enhance protection of homes and communities.

References


10. Austin, Dennis, 1998. pers. comm.
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